Total Maximum Daily Loads
for
Middle Creek: LP2-21100

Parameter of Concern: Atrazine

Nebraska Department of Environmental Quality
Planning Unit, Water Quality Division

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Executive Summary

Middle Creek was included in the 2006 Nebraska Surface Water Quality Integrated Report (NDEQ 2006a) in Category 5 as impaired by excessive atrazine. As such, a total maximum daily load (TMDL) must be developed in accordance with the Clean Water Act. The information contained herein should be considered one TMDL.

This TMDL has been prepared to comply with the current (1992) regulations found at 40 CFR Part 130.7.

1. **Name and geographic location of the impaired waterbody for which the TMDL is being developed.**
   Lower Platte River Basin: Middle Creek LP2-21100.

2. **Identification of the pollutant and applicable water quality standard**
   The pollutants causing the impairment(s) of the water quality standards and designated beneficial uses (for which a TMDL will be developed) is atrazine. Designated uses assigned to the above-identified segments include: primary contact recreation, aquatic life Warmwater class B, agriculture and industrial water supplies class A and aesthetics (NDEQ 2006b). Excessive atrazine has been determined to be impairing the aquatic life beneficial use.

3. **Quantification of the pollutant load that may be present in the waterbody and still allows attainment and maintenance of the water quality standards.**
   TMDLs are often expressed in terms of mass per time. This is accomplished with accurate flow and concentrations information. The data is lacking for Middle Creek to calculate load and regulations allow for TMDLs to be expressed in other appropriate measures. For this TMDL the loading capacity will be the applicable water quality criteria for atrazine applied to the TMDL is 12 μg/l.

4. **Quantification of the amount or degree by which the current pollutant load in the waterbody, including upstream sources that is being accounted for as background loading deviates from the pollutant load needed to attain and maintain water quality standards.**
   Assessment of May-June atrazine data indicates 5 of 7 values exceed the applicable criteria.

5. **Identification of the pollutant source categories.**
   The entire atrazine pollutant source has been determined to originate from nonpoint sources.

6. **Wasteload allocations for pollutants from point sources.**
   The wasteload allocation for atrazine will be zero (0).

7. **Load allocations for pollutants from nonpoint sources.**

   The load allocations assigned to this atrazine TMDL will be the water quality criteria of 12 μg/l.

8 **A margin of safety.**
   This TMDL contain an implicit and explicit margin of safety. The reduction necessary to support the beneficial use will be set at 73% whereas only a 30% reduction is needed. Also, implementation of controls will result in year-round protection of water quality. This will be important should application practices change in the future.

9. **Consideration for seasonal variation.**
   Assessment and analysis of the data, as well as the TMDL was based on the May-June timeframe when atrazine application generally occurs and deviations from the water quality criteria have been observed.

10. Allowances for reasonably foreseeable increases in pollutant loads.
There was no allowance for future growth included in this TMDL.

11. Implementation Plan
The lead agency for pesticides and water quality issues in Nebraska is the Department of Agriculture (NDA). Implementation of the reductions for atrazine will be coordinated with the NDA.

This TMDL included in the following text can be considered a "phased TMDL" and as such are an iterative approach to managing water quality based on the feedback mechanism of implementing a required monitoring plan that will determine the adequacy of load reductions to meet water quality standards and revision of the TMDL in the future if necessary. A description of the future monitoring (Section 4.0) that is planned has been included.

Monitoring is essential to all TMDLs in order to:

- Assess the future beneficial use status;
- Determine if the water quality is improving, degrading or remaining status quo;
- Evaluate the effectiveness of implemented best management practices.

The additional data collected should be used to determine if the implemented TMDL has been or is effective in addressing the identified water quality impairments. As well the data and information can be used to determine if the TMDLs have accurately identified the required components (i.e. loading capacity, load allocations, etc.) and if revisions are appropriate.

1.0 Introduction

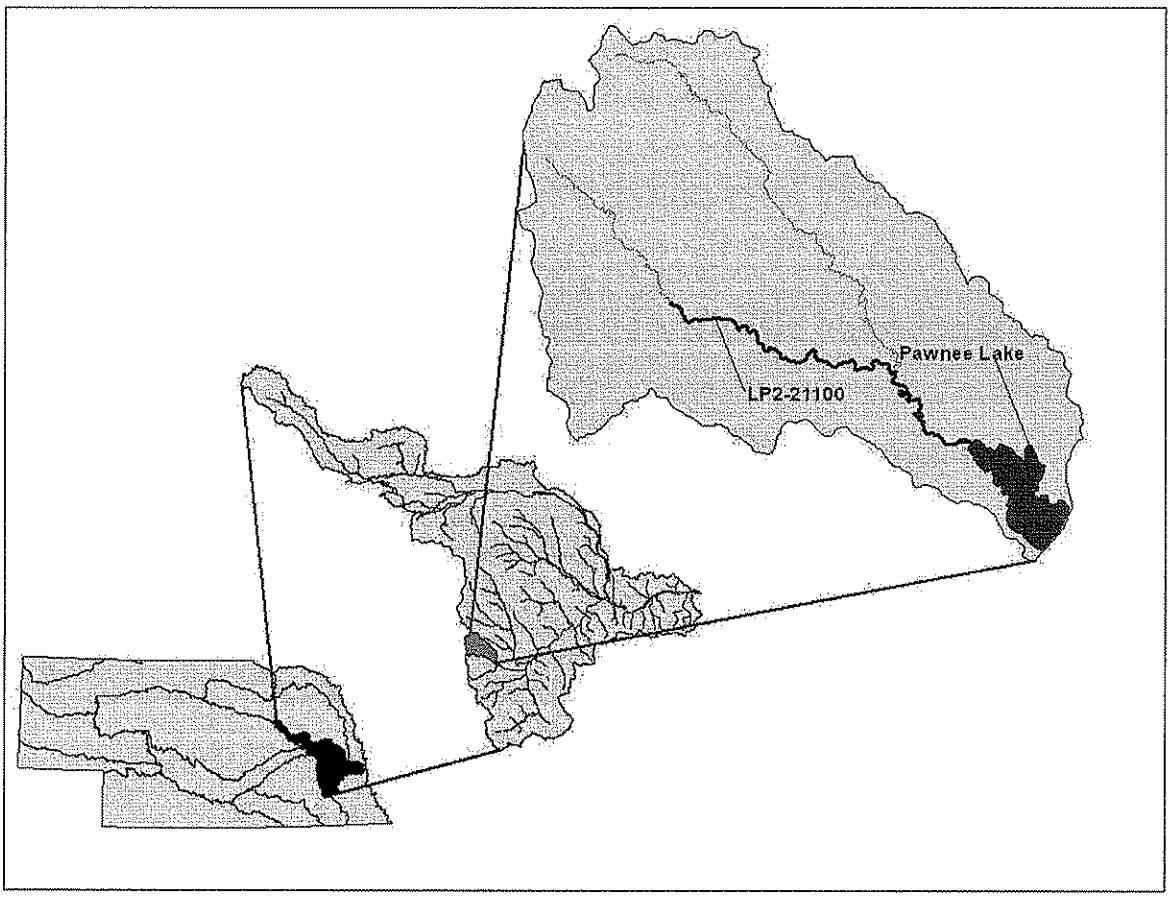
Middle Creek – Segment LP2-21100 – was included on Category 5 of the 2006 Nebraska Surface Water Quality Integrated Report (IR) (NDEQ 2006c). Category 5 is the Section 303(d) list of waterbodies that have been deemed impaired by one or more parameters and are in need of a TMDL. Data collected from 2002-2004 indicate the aquatic life beneficial use is impaired with the parameter of concern being atrazine.

Based on the above, and as required by Section 303(d) of the Clean Water Act and 40 CFR Part 130, TMDLs have been developed for Middle Creek to address atrazine. Therefore, the information contained herein should be considered one (1) TMDL.

1.1 Background Information

Middle Creek is a tributary of Salt Creek (LP2-20000) within sub-basin 2 of the Lower Platte River Basin. The stream heads in eastern Seward County and generally flows southeast (Figure 1.1) to the confluence with South Middle Creek (LP2-21010). Pawnee Lake (LP2-L0160) lies on Middle Creek, approximate1.5 miles from the South Middle Creek confluence.

Figure 1.1 Middle Creek in the Lower Platte River Basin



1.1.1 Waterbody Description

1.1.1.1 Waterbody Name and Stream Identification Number: Middle Creek – LP2-21100

1.1.1.2 Major River Basin: Missouri

1.1.1.3 Minor River Basin: Lower Platte

1.1.1.4 Hydrologic Unit Code (8 digit): 10200203

1.1.1.5 Assigned Beneficial Use: Warmwater aquatic life – class B, agriculture class A and aesthetics (Title 117 – Nebraska Surface Water Quality Standards).

1.1.1.6 Tributaries: None

Table 1.1 Physical Description of Middle Creek

Parameter	Middle Creek
State	Nebraska
County (whole or in part)	Lancaster and Seward Counties
Watershed Area	37 mi^2
Designated Stream Segments	1
Stream Miles (designated)	9.6 miles

1.1.2 Watershed Characteristics

1.1.2.1 Physical Features: The Middle Creek watershed encompasses approximately 37 mi^2 in eastern Seward and western Lancaster County. The watershed ends with the confluence of South Middle Creek. The ecoregions of the basin include the Western Corn Belt Plains (Chapman, et. al. 2001). Agriculture is the major land use.

The watershed is dominated by uplands, which consist of areas of glacial till covered with loess. Six major soil associations are present in the watershed including: Burchard-Steinauer, Pawnee-Sharpsburg, Sharpsburg-Pawnee-Burchard, Sharpsburg Jundson found in the upland and the Hobb-Hall and Kennebeck-Nodaway-Zook found in the lowlands (LPSNRD 1992).

1.1.2.2 Climate: The average annual precipitation is approximately 28 inches (High Plain Regional Climate Center Web Site) with a majority of the precipitation occurs during the spring and early summer. Temperatures in the basin range from an average high in the upper 80's during the summer to average lows in the 10's during the winter.

1.1.2.3 Demographics: The village of Garland – population 247 lies at the western edge of the watershed. As well, the City of Lincoln – population 226,081 lies to the east. The 1992 estimated population of the watershed was 800 (LPSNRD 1992). This estimate is likely less than the present day population due to the numerous acreages that have been developed.

1.1.2.4 Land Use: Agriculture activities dominate the land use with most of the land being used as cropland or pasture. Important crops included corn, milo, winter wheat soybeans and hay. Dairy and beef cattle are also raised in the watershed (LPSNRD 1992).

2.0 Atrazine TMDL

2.1 Problem Identification

Segment LP2-21100 was included in Category 5 of the 2006 Integrated Report as having an impaired aquatic life beneficial use with the parameter of concern being atrazine. This section deals with the extent and nature of the water quality impairments caused by excessive atrazine in the Middle Creek watershed.

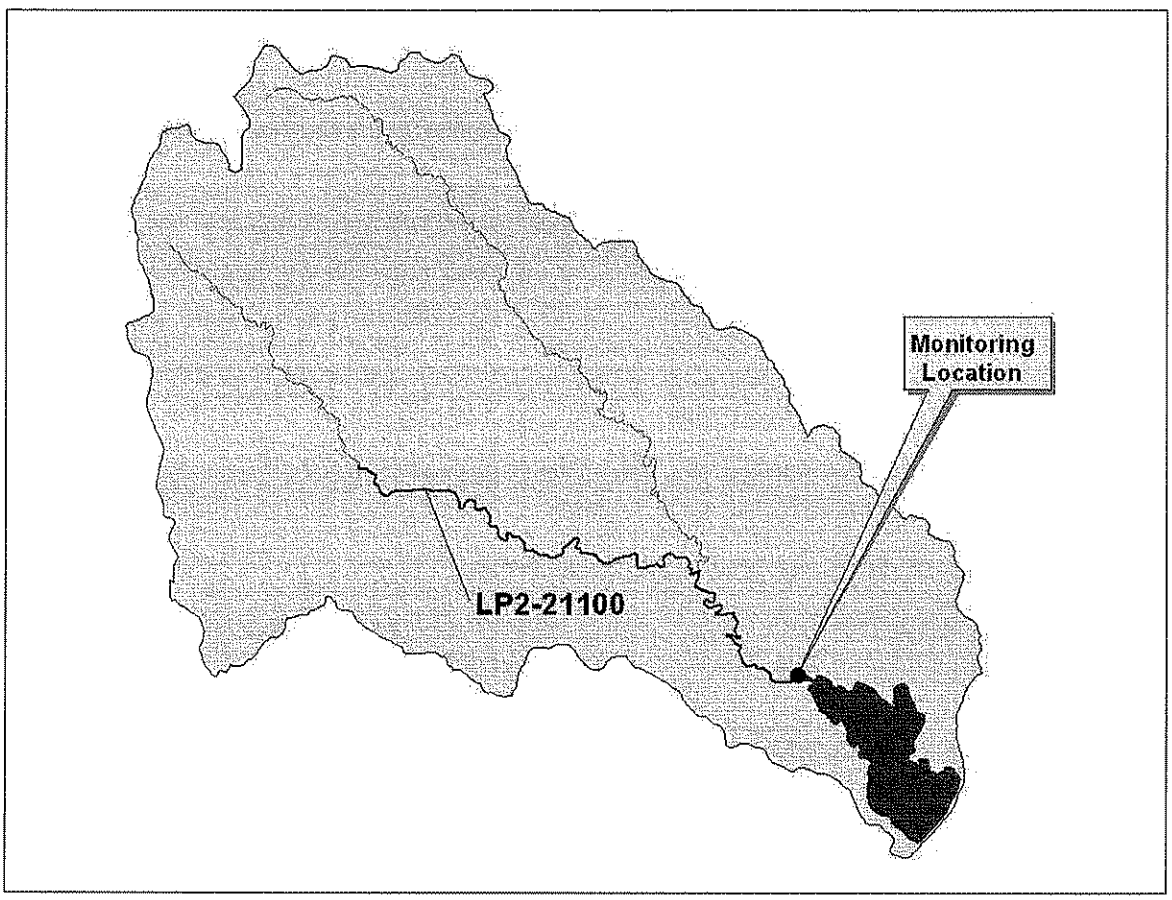
2.1.1 Water Quality Criteria Violated and/or Beneficial Uses Impaired

The Warmwater B-Aquatic Life beneficial use has been deemed impaired within LP2-21100. The warmwater B aquatic life beneficial use applies to surface waters where a variety of warmwater biota is presently limited by water volume of flow, water quality (natural or irretrievable human-induced conditions), substrate composition, or other habitat conditions. These waters are only capable of maintaining year-round populations of tolerant warmwater fish and associated vertebrate and invertebrate organisms and plants. Key species may be supported on a seasonal or intermittent basis (e.g., during high flows) but year round populations cannot be maintained (NDEQ 2006a).

2.1.2 Data Sources

Atrazine data is collected as part of the Salt Valley Lakes Runoff Monitoring program. Within the runoff monitoring program, samples are collected to characterize stormwater influenced streams feeding the Salt Valley Lakes (Figure 2.1.2). There is a target of four sampling events per waterbody, per year.

Figure 2.1.2 Monitoring Location on Middle Creek



2.1.3 Water Quality Assessment

Water quality data assessments were based upon the beneficial use assessment procedures used to identify Category 5/impaired waters for the 2006 Integrated Report. The procedures are based on the application of the "binomial distribution" method that applies a confidence interval to the exceedance rate in an effort to determine the true exceedance of the waterbody versus the data set. A complete description of the water quality data assessment procedures can be found in the *Methodologies for Waterbody Assessments and Development the 2006 Integrated Report for Nebraska*, January 2006.

In the assessment process, all data will be initially assessed for seasonal variability in concentration or occurrence. This process will be accomplished by creating charts of time-series plots for each parameter of interest. These charts will be created from data gathered within the most recent 5-year monitoring period, or where continuous datasets exist (i.e., no more than a 2-year gap in data availability) over longer periods of time. If review of these charts reveals that seasonal differences occur, the NDEQ will focus its assessment efforts within the season(s) where parameter concentrations/occurrence are evident. By examining only the timeframe (seasons) where parameters appear in detectable levels, or at or near levels of concern, a waterbody can be more accurately assessed for use support / impairment. In contrast, when seasonal differences are present, but a long-term database is used to assess beneficial use support, the impacts to beneficial uses are underestimated and waters where real seasonal concerns exist may be overlooked.

The details of the assessment process to determine the use support of the Aquatic Life beneficial use can be found in table 2.1.3

Table 2.1.3 Assessment of the Aquatic Life Beneficial Use Using Chemical Water Quality Data

Supported	Impaired
≤10% of samples exceed acute or chronic water quality criteria	>10% of samples exceed acute or chronic water quality criteria

2.1.4 Water Quality Conditions

Atrazine data collected from 2002-2004 was assessed to determine the beneficial use support for the warmwater B aquatic life designation. Table 2.1.4 and figure 2.1.4 presents this information.

Table 2.1.4 Middle Creek 2002-2004 Data Assessment

Date Range	Number of Samples	Number of Samples >12 μg/l
January-December	9	5
May-June	7	5

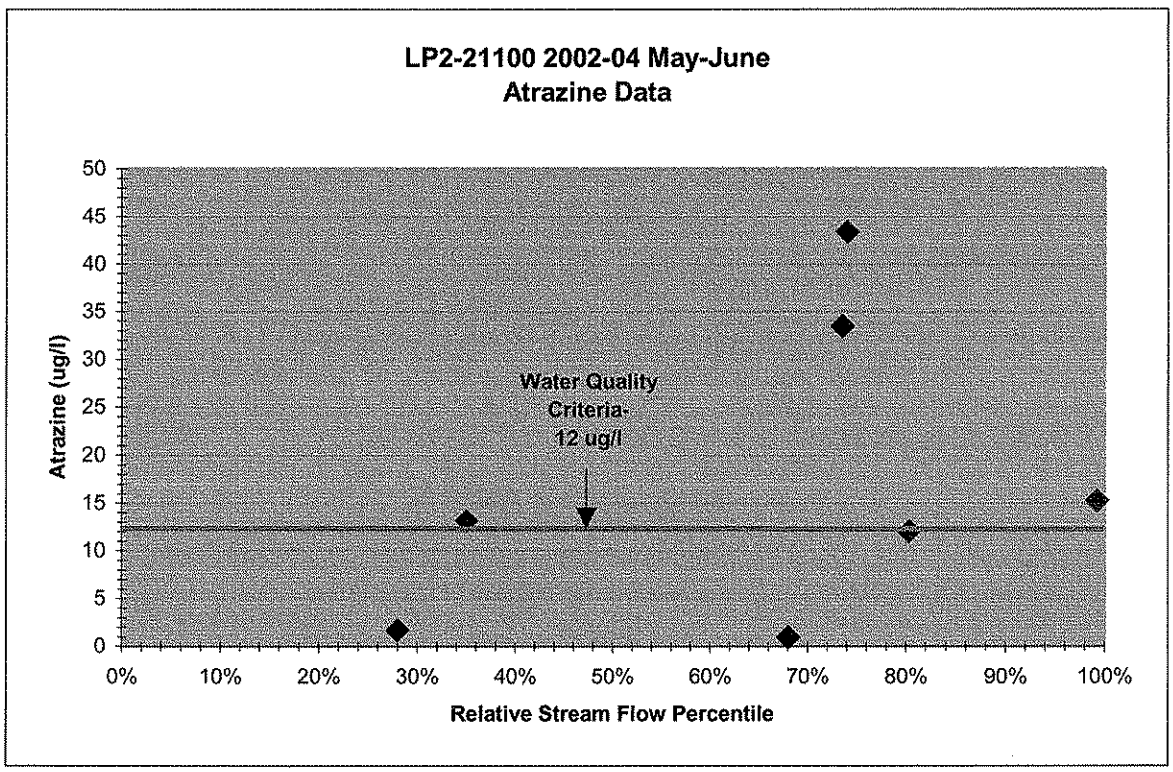
From the data assessment process a seasonal concern/impairment (May-June) exists for atrazine, which coincides with observed periods of increased precipitation and application of the herbicide. Because the impairment is seasonal, this TMDL will focus on that period.

2.1.5 Potential Pollutant Sources

Atrazine is a triazine herbicide currently registered for use against broadleaf and some grassy weeds. Atrazine is currently registered for use on corn (field and sweet); sorghum; range grasses for the establishment of permanent grass cover on rangelands and pastures under USDA's Conservation Reserve Program (CRP) in OK, NE, TX, and OR; wheat (where application is to wheat stubble on fallow land following wheat harvests; wheat is not the target crop); conifer forests; Christmas tree farms; sod farms; and golf courses (EPA 2006).

Atrazine is one of the most heavily used pesticides in North America (EPA 2003). Given this usage and source, point and natural sources are likely not contributing atrazine to surface waters in Nebraska. Therefore, for this TMDL the entire load will be considered the result of nonpoint source discharges.

Figure 2.1.4 Middle Creek May-June Atrazine Data



2.2 TMDL Endpoint

The endpoint for this TMDL will be based on the numeric criteria associated with the Class B Warmwater Aquatic Life Beneficial Use.

2.2.1 Numeric Water Quality Criteria

Water quality criteria established for the Class B – Warmwater Aquatic Life protection of the beneficial use can be found in Title 117, Chapter 4. Assessment of the data and the TMDL are based on the chronic criterion of 12 µg/l.

2.2.2 Selection of Critical Environmental Conditions

The critical environmental conditions for this TMDL have been identified in the assessment process. Specifically, the data and information will be limited to the May-June timeframe when the deviations from the water quality criteria were observed.

2.2.3 Waterbody Pollutant Loading Capacity

Typically, TMDLs are expressed in terms of a load (mass per unit time). In order to calculate loads, accurate information is needed on the pollutant concentration and waterbody volume. In the case of Middle Creek, the volume would be stream flow measured by cubic feet per second. Unfortunately, no long terms stream gage has been maintained on segment LP2-21100 and the presence of Pawnee Lake creates a some issues when attempting to extrapolate flows, thus accurate flow information is lacking,

According to 40 CFR Part 130.2 TMDLs can be expressed in terms of either mass per time, toxicity or other appropriate measure. For this TMDL concentration will be targeted as an "other appropriate measure".

The measure can be considered appropriate due nonpoint sources being the sole contributor of atrazine to Middle Creek. That is, concentration will be the determining factor as to whether or not a "load" is acceptable. The loads with concentrations less that the criteria are compliant whereas those loads with concentrations greater than the applicable criteria are considered deviations.

Therefore, the waterbody pollutant loading capacity is set at the water quality criteria of 12 μg/l.

In April 2006, the US Court of Appeals – D.C. Circuit ruled in *Friends of the Earth v. EPA et al. (No. 05-5015)* that all TMDLs must be expressed as daily loads. To comply with this ruling, the maximum daily load will be expressed as:

$$\text{Loading capacity} = \text{WQS} * \text{Flow} * \text{C}$$

Where the WQS is equivalent to the water quality standard/criteria, flow is the current stream flow volume and C is conversion factor to achieve results in mass per time.

2.3 Pollutant Source Assessment

As indicated in Section 2.1.5 the only source of atrazine considered for this TMDL is nonpoint source discharges.

2.4 Pollutant Allocation

A TMDL is defined as:

$$\text{TMDL} = \text{Loading Capacity} = \text{WLA} + \text{LA} + \text{Background} + \text{MOS}$$

As stated above, the loading capacity is 12 μg/l

2.4.1 Wasteload Allocation

As stated previously, elevated atrazine concentrations are typically not the result of point source discharges. For this TMDL the wasteload allocation will be zero (0).

2.4.2 Load Allocation

The load allocations assigned to this TMDL will be:

$$LA = 12\ \mu g/l * \text{Current stream Flow} * C$$

Because the WLA and natural background are zero (0) the entire loading capacity is the LA and examples of the applicable LAs/maximum daily loads can be found in Appendix B.

2.4.3 Natural Background

Atrazine does not occur naturally in the environment therefore the allocation for natural background will be zero (0).

2.4.4 Load Reduction to Meet Water Quality Criteria

It is important to report the reductions necessary to meet the water quality criteria. The necessary reductions were determined based upon the 2002-04 data, which is considered representative information. The targeted reductions provide water quality managers with a quantitative endpoint by which implementation planning can be carried out. In order to meet full support status the atrazine load must be reduced by 73%.

2.4.5 Margin of Safety

The margin of safety for this TMDL is both implicit and explicit and will be:

- The targeted reduction will result in no measurements exceeding the 12 μg/l criteria. Assessment procedures allow for two deviations from water quality standards with three being the threshold for impairment. A 30% reduction will result in 2 deviations. Therefore, the explicit margin of safety is 43%.
- Assessment of the data and the TMDL focused on the critical period where application of atrazine occurs. Implementation of controls will result in year-round protection of water quality. This will be important should application practices change in the future.

3.0 Implementation Plan

The implementation of controls to manage atrazine within the Middle Creek watershed includes but is not limited to:

3.1 Nebraska Department of Agriculture

The Nebraska Pesticide Act provides that the Nebraska Department of Agriculture (NDA) shall serve as the lead state agency in matters relating to pesticides and water quality. It further provides that NDA shall work closely with the Nebraska Department of Environmental Quality, Nebraska Department of Natural Resources, and the Nebraska Department of Health in matters relating to water quality.

Since 1995, the NDA has been the lead agency for the regulation of pesticides that might enter or pollute water and is responsible for development and implementation of state management plans for the prevention, evaluation and mitigation of occurrences of pesticides, or pesticide breakdown products, in ground and surface water. By working closely with those state agencies listed above as well as the Natural Resources Districts and others, NDA can be assured that the plans will be more comprehensive and effective in addressing these issues.

The NDA has been consulted in the completion of this TMDL and will be provided a copy upon EPA approval.

3.2 Section 319 – Nonpoint Source Management Program

The United States Environmental Protection Agency supplies grant funds to states to aid in managing nonpoint source pollution. When grant applications are submitted for review, an effort should be made to include the control of atrazine and surface run-off for the proposed projects in the Middle Creek watershed. As well, an effort will be made to redirect applicants to develop proposals consistent with the goals of this TMDL.

3.3 USDA-Natural Resource Conservation Service

The USDA-Natural Resource Conservation Service provides assistance utilizing programs under the control of the Service such as Conservation Reserve Program, Environmental Quality Incentives Program, Conservation Farm Option, Conservation of Private Grazing Land Initiative, the Wetlands Reserve Program and others that aid in the maintenance and improvement of water quality. The TMDL will be forwarded to NRCS for consideration in the implementation of these programs.

3.4 Non-Government Organizations

Several non-governmental organizations with an emphasis on agriculture disseminate information to their members on a regular basis. As well, some of the organizations have established environmental education programs to assist in the understanding of environmental regulations and topics. The NDEQ will communicate with these entities in an attempt to utilize the membership distribution process as a means of providing information on the water quality impairments, the TMDL and suggestions to assist in solving the identified problems.

3.5 Reasonable Assurance

As stated above, the NDA is the lead agency for issues that deal with pesticides and water quality. The TMDL was provided to the NDA prior to submittal for approval/disapproval. Once approved, coordination with the NDA will continue, including data collection and prioritization and nonpoint source program administration.

Effective management of nonpoint source pollution in Nebraska necessarily requires a cooperative and coordinated effort by many agencies and organizations, both public and private. Each organization is uniquely equipped to deliver specific services and assistance to the citizens of Nebraska to help reduce the effects of nonpoint source pollution on the State's water resources. While a few of the organizations have been previously identified, Appendix A is a more complete compilation of those entities that may be included in the implementation process. These agencies have been identified as being responsible for program oversight or fund allocation that may be useful in addressing and reducing atrazine contributions to the Middle Creek watershed. Participation will depend on the agency/organization's program capabilities.

4.0 Future Monitoring

Future monitoring will generally be consistent with the Salt Valley Lake Runoff Monitoring Program. As well, consideration will be given to expanding the monitoring to isolate areas of concern and to focus resources to address identified problems.

5.0 Public Participation

The availability of the TMDL in draft form was published in the Lincoln Journal Star with the public comment period running from approximately May 14, 2007 to June 18, 2007. This TMDL was also made available to the public on the NDEQ's Internet site and interested stakeholders were informed via email of the availability of the draft TMDL. No comments were received during the public participation period.

6.0 References

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NDEQ 2006a. Title 117 – Nebraska Surface Water Quality Standards. Nebraska Department of Environmental Quality. Lincoln, NE.

NDEQ 2006b. Methodologies for Waterbody Assessments and Development the 2004 Integrated Report for Nebraska. Nebraska Department of Environmental Quality. Lincoln, NE.

NDEQ 2006c. 2004 Surface Water Quality Integrated Report. Nebraska Department of Environmental Quality. Lincoln, NE.

Appendix A – Federal, State Agency and Private Organizations Included in TMDL Implementation.

FEDERAL

- *Bureau of Reclamation*
- *Environmental Protection Agency*
- *Fish and Wildlife Service*
- *Geological Survey*
- *Department of Agriculture - Farm Services Agency*
- *Department of Agriculture - Natural Resources Conservation Service*

STATE

- Nebraska Association of Resources Districts
- Department of Agriculture
- Department of Environmental Quality
- Department of Roads
- Department of Water Resources
- Department of Health and Human Services
- Environmental Trust
- Game and Parks Commission
- Natural Resources Commission
- University of Nebraska Institute of Agriculture and Natural Resources (IANR)
- UN-IANR: Agricultural Research Division
- UN-IANR: Cooperative Extension Division
- UN-IANR: Conservation and Survey Division
- UN-IANR: Nebraska Forest Service
- UN-IANR: Water Center and Environmental Programs

LOCAL

- Natural Resources Districts
- County Governments (Zoning Board)
- City/Village Governments

NON-GOVERNMENTAL ORGANIZATIONS

- Nebraska Wildlife Federation
- Pheasants Forever
- Nebraska Water Environment Association
- Nebraska Corn Growers Association, Wheat Growers, etc.
- Nebraska Cattlemen's Association, Pork Producers, etc
- Other specialty interest groups
- Local Associations (i.e. homeowners associations)

Appendix B – Examples of Maximum Daily Loadings for Various Middle Creek Flows

Flow Value (cfs)	Maximum Daily Load (kg/day)
1	0.03
5	0.15
10	0.29
15	0.44
20	0.59
25	0.73
50	1.47
100	2.94